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ABSTRACT

Community is an essential aspect of the Schools for Thought program, an educational reform project designed to bring educational technology to many public school classrooms. The classroom community is enriched when experts from the surrounding community visit to share knowledge and expertise. Art experiences may help students engage more deeply in content learning. In a pilot study, sixth-grade students learned about the scientific principles behind modern telescopes from a visiting expert in the "Mission to Mars" drawing lesson. The experimental groups (42 students in 2 classes) outscored control groups (35 students in 2 classes) on discrete assessments measuring student content learning about telescopes. On an open-ended assessment, students from the experimental groups were able to explain how a telescope works more often than control students could. Students in the experimental groups were more likely to draw an accurate picture of a telescope than were students in the control group. (Author/SLD)

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The Mission to Mars Drawing Lesson

A Schools for Thought Pilot Study

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ABSTRACT

Community is an essential aspect of the Schools for Thought program. The classroom community is enriched when experts from the surrounding community visit to share knowledge and expertise. Art experiences may help students to deeply engage in content learning. In a pilot study, students learned about the scientific principles behind modern telescopes in the Mission to Mars Drawing Lesson. Experimental groups outscored control groups on discrete assessments measuring student content learning about telescopes. On an open-ended assessment experimental students were able to explain how a telescope works more often than control students. Students in the experimental groups were more likely to draw an accurate picture of a telescope than were students in the control group.

INTRODUCTION

The Schools for Thought classroom is a community within a community. The community inside the classroom considers the contribution of every student vital to the learning of the whole group. Surrounding the classroom community is a community of caring teachers, researchers, content experts, and business leaders, working to structure and share curriculum that will nurture deep understanding and critical thinking skills in the experts of tomorrow. Schools for Thought students have an opportunity to learn that the community outside of the classroom is a valuable source of knowledge and expertise when an expert comes to the classroom as a visiting teacher to share information or help with a project. In this study, an expert in visual art and science visited one sixth grade teacher's Schools for Thought classroom to help students learn how to make accurate, large scale visual aids for their group presentations during the Mission to Mars starter unit.

Schools for Thought (SFT) is an educational reform project being implemented in a growing number of public school classrooms in the United States and Canada. SFT seeks to transform the entire school day through the use of computer technology, situated learning environments, involvement in a learning community, and a knowledge centered curriculum. In SFT, the teacher becomes a facilitator of student learning while modeling what it means to be an expert learner connected to a community of content area specialists who share their expertise with the classroom. SFT students work in small groups to conduct research on real-life dilemmas that integrate critical thinking skills with content knowledge.

Mission to Mars is a sixth grade SFT science unit that poses a dilemma for students to solve: Can people travel to other planets and what do we need to know in order to achieve that goal? A starter unit asks students to search for information about each planet in the solar system in order to determine which one could possibly be visited by human beings. Once students determine that Mars

is the only planet that has suitable conditions for human exploration, work on the Mission to Mars unit begins. Students watch a video anchor about space missions, generate questions and break out into small groups to conduct research about specific aspects of the problem. Ultimately the students switch to jigsaw groups that make use of their distributed expertise to produce a feasibility study and a final presentation about what it would take for humans to travel to Mars.

METHODOLOGY

Subjects. The subjects of this study were the sixth graders in four Schools for Thought classrooms (N=77) in the Metropolitan Nashville School System in Nashville Tennessee. Two classes comprised the experimental group (n=42) and two classes comprised the control group (n=35). These groups were located in two different schools, but because both are SFT classrooms, the curriculum and team teaching approach are very similar for both groups. Both control classes have the same teacher for science and social studies, and both experimental classes have the same teacher for science and social studies. At the time of this study, students in both experimental and control groups were at the point of gathering information about each planet in the solar system to determine which one could be the target of a manned space mission.

Procedure: Experimental Group. Before the drawing lesson, students were given a written pre-test of discrete and open-ended questions. After the test, the visiting expert asked the students to consider the means used by people to gather information about the planets in the solar system. A discussion ensued where many students referred to telescopes, but none could explain in any detail the principles or mechanisms involved in a telescope in class. After the discussion, the expert gave students pictures of six different kinds of telescopes found in The Harper Encyclopedia of Science (first edition), located in their school library. Students were guided through an art lesson where they learned how to enlarge the pictures with 9"x12" tracing paper, 9"x12" graph paper with 1/4 inch squares,

and 30"x 36" graph paper with 1 inch squares.Once the students had completed the enlarged drawings, each group was asked to explain how the telescope in their drawing worked. Students were allowed time to conduct research using text resources, including text from the encyclopedia that contained the original pictures of telescopes. The students in each group gave an explanation about their drawing to the expert who asked questions pertaining to the principles involved in the various telescopes. After this experience, students were administered a written post-test identical to the written pre-test. This procedure took place over the course of three days.

Control Group. Meanwhile, in another sixth grade Schools for Thought classroom, students (n=35) were given the same written pre-tests as the experimental group. Students were then given the same pictures and text resources as the experimental group, but they did not receive the drawing lesson, nor were they asked to present any information about telescopes. They were not given any instructions that prohibited activities regarding the text and picture resources. Students read the resources, looked at the pictures, and talked among themselves in small groups. When they indicated that they were finished with the resources, they were given a written instrument, identical to the pre-test, as a post-test. This procedure took place over the course of three days.

Analysis of Data. The discrete written instrument surveyed the opinions of experimental and control groups about 18 statements regarding optical and radio telescopes, and scientific principles regarding optics and wave-form phenomena. For each statement, students were asked to select one of five choices to indicate their opinion (the choices were assigned values of: 1) I strongly agree; 2) I think so; 3) I don't know; 4) I don't think so; 5) I strongly disagree). False statements were re-coded during analysis so that a value of 1 indicated the correct answer. Please note that, in the discrete measure, a lower score is a better score.

The open-ended written instrument asked students to first list the names of all of the different kinds of telescopes that they knew. They were then asked to

pick a telescope from the list and explain how it worked. Students had been instructed that they could use words, draw pictures, or both, to answer the second question. Data on the open-ended instrument was coded for the presence or absence of an answer, the number of accurate phrases used to explain how the telescope worked, the presence or absence of a drawing as an explanation, and whether or not the drawing was a reasonably accurate explanation of how a telescope works (by reasonably accurate we mean that we were concerned with whether or not students drew the path of the light through the telescope in an accurate manner, or if they indicated the path of radio waves in drawings of radio telescopes). Please note that in the open-ended measure, a higher score is a better score. We achieved 89% reliability in the open-ended coding.

RESULTS

Telescopes are interesting devices to many middle school students. Because some students may have had prior experience with telescopes, an analysis of covariance between pre and post instruments was used with both discrete and open-ended data for both control and experimental groups. On the discrete instrument a significant main effect was found between experimental and control groups on only three statements. The first read: "The first telescope was invented by a European named Galileo in 1610." The experimental group out performed the control group F (1, 74) = 6.981, $p<.01$ on this question (mean =1.7561, Std Dev = 1.2406 for experimental group; mean = 2.5294, Std Dev = 1.3311 for control group). The second of these statements read: "Images seen through a telescope are upside down". The experimental group out performed the control group F (1, 76) = 11.074, $p<.001$ on this question (mean = 2.5000, Std Dev = 1.8369 for experimental group; mean = 3.6286, Std Dev = 1.1398 for control group). The third of these statements read: "White light is broken into different colors when it passes through a lens." The experimental group out performed the control group F (1, 75) = 5.057, $p<.05$ on this question (mean = 2.1667, Std Dev = 1.5128 for experimental group; mean = 2.8571, Std Dev =

1.1152 for control group). On no questions did the control group out perform the experimental group.

On the open-ended instrument a significant main effect was found on all factors analyzed, except the presence or absence of an answer. The experimental group used more phrases to explain how a telescope works, $F(1, 75) = 13.943$, $p<.0001$ than the control group (mean = 1.4286, Std Dev = 1.4507 for experimental group; mean = .6765, Std Dev = .9761 for control group; at post test). The experimental group more often drew an accurate picture to explain how a telescope works $F(1, 76) = 9.572$, $p<.005$ than the control group (mean = .2857, Std Dev = .4572 for experimental group; mean = .0571, Std Dev = .2355 for control group; at post test).

DISCUSSION

The Mission to Mars unit presents students with a great deal of information about space technology during the course of their research. It is questionable that students really understand how such technology works through reading or looking at pictures. Certainly it is not feasible to ask students to understand the workings of every type of technology they encounter in their research. However, it would seem that students are capable of understanding rather complex scientific principles when they are engaged in a task that requires deep and sustained interaction with some aspect the technology involved in space exploration.

This pilot study indicates that the Mission to Mars Drawing Lesson is one way to get students deeply involved with the scientific principles behind modern technology. This sustained involvement allows students to learn more than they would through reading alone.

It is possible that learning to enlarge a drawing captures the students' interest and motivates them to be able to be to explain their drawing to an audience. Further research needs to be conducted to determine what types of art experiences can facilitate content learning across the middle school curriculum.

It is also possible that the presence of a visiting expert in the classroom can capture students' interest and motivate them to stay with a complex task until they, too, become experts. Further research needs to be conducted to determine what types of interactions with the outside community can facilitate learning and the development of critical thinking skills in middle school students.

References

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